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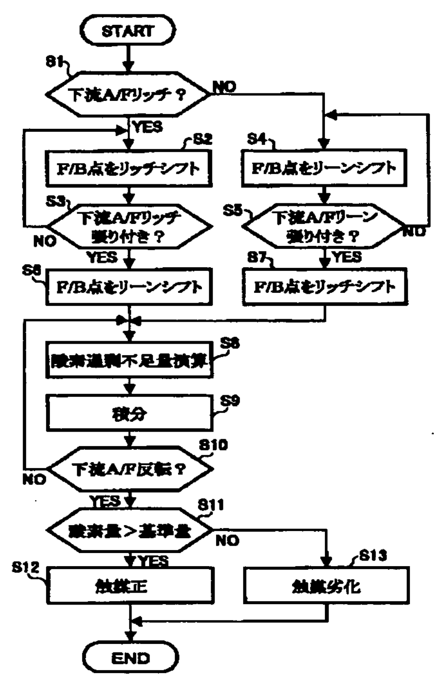
(54)【発明の名称】　内燃機関の触媒劣化診断装置

(57)【要約】
【課題】三元触媒の酸素ストレージ能力の劣化を高精度に診断できるようにする。
【解決手段】触媒上流側の空燃比をリッチ又はリーンにシフトさせ、三元触媒における酸素ストレージ量を０又は最大量に初期化する（Ｓ１～Ｓ５）。その後、触媒上流の空燃比を反転させて（Ｓ６，Ｓ７）、酸素ストレージ量が増大又は減少変化するようにし、前記反転後の酸素過剰量又は不足量を算出して時間積分させる（Ｓ８，Ｓ９）。そして、触媒下流側の空燃比が反転すると（Ｓ10）、それまでに積算された酸素過剰量又は不足量と基準酸素量とを比較し（Ｓ11）、基準酸素量よりも少ないときに三元触媒の劣化を判定する（Ｓ13）。



【特許請求の範囲】

【請求項１】内燃機関の排気通路に介装される酸素ストレージ能力を有する三元触媒の劣化を診断する触媒劣化診断装置であって、

前記三元触媒下流側の排気空燃比のリッチ・リーンと、前記三元触媒に対する流入酸素量との相関から前記三元触媒の酸素ストレージ能力の劣化を診断することを特徴とする内燃機関の触媒劣化診断装置。

【請求項２】前記三元触媒の下流側の排気空燃比がリッチ又はリーンに張り付いている状態から、該下流側の排気空燃比を反転させるべく前記三元触媒の上流側の排気空燃比をリーン又はリッチに制御し、該上流側の排気空燃比の制御を開始してからの前記三元触媒に対する流入酸素量の過剰分又は不足分を積算し、前記下流側の排気空燃比がリーン又はリッチに反転した時点の前記積算値が基準値以下であるときに、前記三元触媒の酸素ストレージ能力の劣化発生を診断することを特徴とする請求項１記載の内燃機関の触媒劣化診断装置。

【請求項３】前記流入酸素量の過剰分又は不足分を、前記三元触媒の上流側の排気空燃比の理論空燃比からのずれ量と排気流量とから算出することを特徴とする請求項２記載の内燃機関の触媒劣化診断装置。

【請求項４】内燃機関の排気通路に介装される酸素ストレージ能力を有する三元触媒の劣化を診断する触媒劣化診断装置であって、

前記三元触媒の上流側の排気通路に介装され、排気空燃比をリニアに検出する空燃比センサと、

該空燃比センサで検出される空燃比を目標空燃比に一致させるべく機関の燃焼混合気の空燃比をフィードバック制御する空燃比フィードバック制御手段と、

該空燃比フィードバック制御手段による空燃比フィードバック制御の制御点をリッチ又はリーンにシフトさせる初期化手段と、

前記三元触媒の下流側の排気通路に介装され、排気空燃比がリッチかリーンかを検出する酸素センサと、

前記初期化手段による制御点のシフトを行ってから前記酸素センサで検出される排気空燃比がリッチ又はリーンに張り付いたことに基づいて、前記空燃比フィードバック制御手段による空燃比フィードバック制御の制御点をリーン又はリッチに反転させる空燃比反転手段と、

機関の排気流量を検出する排気流量検出手段と、

前記空燃比反転手段による制御点の反転を行ってからの前記三元触媒に対する流入酸素量の過剰分又は不足分を、前記空燃比センサで検出される排気空燃比の理論空燃比に対するずれ量と前記排気流量検出手段で検出される機関の排気流量とから算出して積算する流入酸素量算出手段と、

前記空燃比反転手段による制御点の反転に対応して前記酸素センサで検出される排気空燃比が反転したときに、それまでに前記流入酸素量算出手段で積算された流入酸素量の過剰分又は不足分と予め記憶された基準酸素量とを比較して、前記三元触媒の酸素ストレージ能力の劣化を診断する劣化診断手段と、

を含んで構成されたことを特徴とする内燃機関の触媒劣化診断装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は内燃機関の触媒劣化診断装置に関し、特に、酸素ストレージ能力を有する三元触媒の酸素ストレージ能力の劣化を診断する装置に関する。

【０００２】

【従来の技術】従来、機関の排気系に介装される三元触媒の上流側に、空燃比をリニアに検出する空燃比センサを備え、該空燃比センサによって空燃比フィードバック制御を行う機関において、前記三元触媒の下流側に空燃比が理論空燃比に対してリッチかリーンかを検出する酸素センサを設け、該酸素センサの出力の軌跡長又は前記酸素センサの出力の軌跡長と前記空燃比センサの出力の軌跡長との比に基づいて、三元触媒の劣化を診断する診断装置があった（特開平９－１２５９３６号公報参照）。

【０００３】

【発明が解決しようとする課題】しかしながら、上記従来の劣化診断装置によると、空燃比センサの出力の軌跡長が所定範囲であるときには信頼性の高い診断が行えるが、前記所定範囲外では誤診断の可能性があって、診断可能な条件が限定されるという問題があった。

【０００４】本発明は上記問題点に鑑みなされたものであり、三元触媒の酸素ストレージ能力の劣化を、誤診断なくかつ確実に診断できる診断装置を提供することを目的とする。

【０００５】

【課題を解決するための手段】そのため請求項１の発明にかかる内燃機関の触媒劣化診断装置は、内燃機関の排気通路に介装される酸素ストレージ能力を有する三元触媒の劣化を診断する触媒劣化診断装置であって、前記三元触媒下流側の排気空燃比のリッチ・リーンと、前記三元触媒に対する流入酸素量との相関から前記三元触媒の酸素ストレージ能力の劣化を診断する構成とした。

【０００６】例えば三元触媒の上流側における排気空燃比がリッチであれば、三元触媒の雰囲気が酸素不足となって、三元触媒に吸着されていた酸素が酸化反応に使用されることになり、三元触媒の酸素ストレージ量が徐々に低下する一方、前記上流側の排気空燃比がリーンであれば、三元触媒の雰囲気が酸素過剰となって、三元触媒の酸素ストレージ量は徐々に増大変化する。従って、三元触媒の下流側の排気空燃比の変化は、上流側の排気空燃比の変化に対して、三元触媒が吸着可能な酸素ストレージ量に応じた遅れを生じることになり、実際の酸素ス

トレージ量は、下流側の空燃比変化が発生するまでに触媒に流入した酸素量から推定できることになり、該推定される酸素ストレージ量が初期状態での酸素ストレージ量よりも減少していれば、三元触媒の酸素ストレージ能力の劣化が判定されることになる。

【０００７】尚、本願において、空燃比のリッチ・リーンは、理論空燃比に対するリッチ・リーンを示すものとする。請求項２記載の発明では、前記三元触媒の下流側の排気空燃比がリッチ又はリーンに張り付いている状態から、該下流側の排気空燃比を反転させるべく前記三元触媒の上流側の排気空燃比をリーン又はリッチに制御し、該上流側の排気空燃比の制御を開始してからの前記三元触媒に対する流入酸素量の過剰分又は不足分を積算し、前記下流側の排気空燃比がリーン又はリッチに反転した時点の前記積算値が基準値以下であるときに、前記三元触媒の酸素ストレージ能力の劣化発生を診断する構成とした。

【０００８】かかる構成によると、触媒下流側の排気空燃比がリッチに張り付いている状態は、酸素ストレージ量が略０になっているものと推定でき、また、リーンに張り付いている状態では、酸素ストレージ量が最大量に達しているものと推定できる。そして、係る状態から酸素ストレージ量を増大又は減少させるべく、上流側の排気空燃比を制御し、下流側の排気空燃比の反転によって酸素ストレージ量が最大量或いは０にまで変化したか否かを判断する。一方、下流側の排気空燃比が反転するまでの触媒に対する流入酸素量の過剰分又は不足分を、実際の酸素ストレージ量に相当する値として求め、所期の酸素ストレージ量よりも減少していれば、三元触媒の劣化を判定する。

【０００９】請求項３記載の発明では、前記流入酸素量の過剰分又は不足分を、前記三元触媒の上流側の排気空燃比の理論空燃比からのずれ量と排気流量とから算出する構成とした。

【００１０】かかる構成によると、上流側の排気空燃比の理論空燃比からリッチ側に空燃比がずれている場合には酸素不足状態であり、リーン側にずれている場合には酸素過剰状態であり、理論空燃比からのずれ量が大きいほど酸素不足又は酸素過剰の度合いが大きくなり、排気流量に応じて酸素過剰量，酸素不足量が求められる。尚、排気流量は、機関の吸入空気流量と略同量であるので、吸入空気流量を排気流量相当値として、酸素過剰分，酸素不足分を求めることができる。

【００１１】請求項４記載の発明は、内燃機関の排気通路に介装される酸素ストレージ能力を有する三元触媒の劣化を診断する触媒劣化診断装置であって、図１に示すように構成される。

【００１２】図１において、空燃比センサは、前記三元触媒の上流側の排気通路に介装され、排気空燃比をリニアに検出する。空燃比フィードバック制御手段は、空燃比センサで検出される空燃比を目標空燃比に一致させるべく機関の燃焼混合気の空燃比をフィードバック制御する。

【００１３】ここで、初期化手段は、空燃比フィードバック制御手段による空燃比フィードバック制御の制御点をリッチ又はリーンにシフトさせる。酸素センサは、前記三元触媒の下流側の排気通路に介装され、排気空燃比がリッチかリーンかを検出するセンサであり、空燃比反転手段は、前記初期化手段による制御点のシフトを行ってから前記酸素センサで検出される前記三元触媒の下流側の排気空燃比がリッチ又はリーンに張り付いたことに基づいて、前記空燃比フィードバック制御手段による空燃比フィードバック制御の制御点をリーン又はリッチに反転させる。

【００１４】流入酸素量算出手段は、空燃比反転手段による制御点の反転を行ってからの前記三元触媒に対する流入酸素量の過剰分又は不足分を、前記空燃比センサで検出される排気空燃比の理論空燃比に対するずれ量と排気流量検出手段で検出される機関の排気流量とから算出して積算する。

【００１５】そして、劣化診断手段は、前記空燃比反転手段による制御点の反転に対応して前記酸素センサで検出される排気空燃比が反転したときに、それまでに前記流入酸素量算出手段で積算された流入酸素量の過剰分又は不足分と予め記憶された基準酸素量とを比較して、前記三元触媒の酸素ストレージ能力の劣化を診断する。

【００１６】かかる構成によると、まず、空燃比フィードバック制御の制御点をリッチ又はリーンにシフトさせることで、酸素ストレージ量を減少又は増大変化させるようにし、該リッチ又はリーンシフトによって下流側の排気空燃比がリッチ又はリーンに張り付いた時点で、酸素ストレージ量が０又は最大量に到達したものと見做す。そして、このようにして初期化された酸素ストレージ量を０から最大又は最大から０にまで変化させるべく、上流側の排気空燃比の制御点をリーン又はリッチに反転させ、該空燃比反転に対応して下流側の空燃比がリーン又はリッチに反転した時点で、酸素ストレージ量が０から最大量或いは最大量から０にまで変化したものと判断し、この間の触媒に対する流入酸素量の過剰分又は不足分が、実際の酸素ストレージ量を示すものとし、基準酸素量、即ち、三元触媒の正常状態での酸素ストレージ量と比較する。

【００１７】

【発明の効果】請求項１の発明にかかる内燃機関の触媒劣化診断装置によると、三元触媒の下流側の排気空燃比のリッチ・リーンから三元触媒における酸素ストレージ量の状態を判断し、該判断結果と三元触媒に対する流入酸素量との相関から、実際の酸素ストレージ量を推定するため、三元触媒の酸素ストレージ能力の劣化を、酸素ストレージ量の低下として定量的に判断でき、以て、劣

化診断を精度良く安定的に行わせることができるという効果がある。

【００１８】請求項２記載の発明によると、三元触媒における酸素ストレージ量を０から最大量又は最大量から０にまで変化させるときの三元触媒に対する流入酸素量から、三元触媒に吸着させることができた酸素量、又は、三元触媒に吸着されていた酸素量を推定でき、以て、三元触媒の酸素ストレージ能力の劣化を精度良く診断できるという効果がある。

【００１９】請求項３記載の発明によると、三元触媒に流入する酸素量の不足分，過剰分を精度良く推定でき、以て、三元触媒における酸素ストレージ量を高精度に推定できるという効果がある。

【００２０】請求項４記載の発明によると、空燃比フィードバック制御の制御点をシフトさせることで、三元触媒における酸素ストレージ量を０から最大量又は最大量から０にまで変化させ、このときの三元触媒に対する流入酸素量から三元触媒における実際の酸素ストレージ量を推定するので、劣化による酸素ストレージ量の減少を精度良く診断できるという効果がある。

【００２１】

【発明の実施の形態】以下に本発明の実施の形態を説明する。実施の形態のシステム構成を示す図２において、内燃機関１には、エアクリーナ２から吸気ダクト３，スロットル弁４及び吸気マニホールド５を介して空気が吸入される。

【００２２】吸気マニホールド５のブランチ部には各気筒毎に燃料噴射弁６が設けられている。前記燃料噴射弁６は、ソレノイドに通電されて開弁し、通電停止されて閉弁する電磁式燃料噴射弁であって、後述するコントロールユニット12からの噴射パルス信号により通電されて開弁し、図示しない燃料ポンプから圧送されプレッシャレギュレータにより所定の圧力に調整された燃料を吸気マニホールド５内に噴射供給する。尚、前記燃料噴射弁６が燃焼室内に直接燃料を噴射する構成であっても良い。

【００２３】機関１の燃焼室にはそれぞれ点火栓７が設けられていて、これにより火花点火して混合気を着火燃焼させる。そして、機関１からは、排気マニホールド８，排気ダクト９，三元触媒10及びマフラー11を介して排気が排出される。前記三元触媒10は、酸素ストレージ効果を有するものであって、排気成分中のＣＯ，ＨＣを酸化し、また、ＮＯx を還元して、他の無害な物質に転換する触媒であり、機関吸入混合気を理論空燃比で燃焼させたときに両転換効率が最も良好なものとなる。

【００２４】コントロールユニット12は、ＣＰＵ，ＲＯＭ，ＲＡＭ，Ａ／Ｄ変換器及び入出力インタフェイスを含んで構成されるマイクロコンピュータを備え、各種のセンサからの検出信号を入力して、後述の如く演算処理して、燃料噴射弁６等の作動を制御する。

【００２５】前記各種のセンサとしては、吸気ダクト３中に熱線式或いはフラップ式などのエアフローメータ13が設けられていて、機関１の吸入空気流量Ｑに応じた電圧信号を出力する。

【００２６】また、クランク角センサ14が設けられていて、所定ピストン位置毎の基準角度信号ＲＥＦと、単位角度毎の単位角度信号ＰＯＳとを出力する。ここで、前記基準角度信号ＲＥＦの発生周期、或いは、所定時間内における前記単位角度信号ＰＯＳの発生数を計測することより、機関回転速度Ｎｅを算出することができる。

【００２７】また、機関１のウォータジャケットの冷却水温度Ｔｗを検出する水温センサ15が設けられている。更に、前記三元触媒10の上流側となる排気マニホールド８の集合部には、排気空燃比をリニアに検出する空燃比センサ16が設けられており、また、前記三元触媒10の下流側でマフラー11の上流側には、排気空燃比のリッチ・リーンを検出する酸素センサ（ストイキセンサ）17が設けられている。

【００２８】ここにおいて、コントロールユニット12に内蔵されたマイクロコンピュータのＣＰＵは、前記各センサによって検出される吸入空気流量Ｑと機関回転速度Ｎｅとに基づいて基本燃料噴射量Ｔｐを演算する一方、冷却水温度Ｔｗなどに基づいて前記基本燃料噴射量Ｔｐを補正するための各種補正係数ＣＯＥＦを演算設定する。

【００２９】また、空燃比フィードバック制御手段としての機能を有するコントロールユニット12は、所定のフィードバック制御条件が成立しているときには、前記基本噴射量Ｔｐを補正するための空燃比フィードバック補正係数ＬＭＤを、前記空燃比センサ16で検出される空燃比が目標空燃比に一致するようにＰＩＤ制御等によって設定する。

【００３０】尚、酸素センサ17で検出される空燃比のリッチ・リーンに基づいて、前記空燃比センサ16を用いた空燃比フィードバック制御に補正を加える構成であっても良い。

【００３１】そして、前記基本燃料噴射量Ｔｐを前記各種補正係数ＣＯＥＦ，空燃比フィードバック補正係数ＬＭＤ、更には、バッテリ電圧による補正分Ｔｓなどによって補正して最終的な燃料噴射量Ｔｉを求め、該燃料噴射量Ｔｉに相当するパルス幅の噴射パルス信号を燃料噴射弁６に所定タイミングで出力する。

【００３２】一方、前記コントロールユニット12には、図３のフローチャートに示すように、前記三元触媒10の劣化、特に、酸素ストレージ能力の劣化を診断するための診断機能が備えられている。

【００３３】図３のフローチャートにおいて、まず、Ｓ１では、酸素センサ17で検出される三元触媒10下流側の排気空燃比（Ａ／Ｆ）がリッチであるかリーンであるかを判別する。

【００３４】そして、リッチであるときには、Ｓ２へ進み、前記空燃比フィードバック制御における制御点（Ｆ／Ｂ点）をリッチ側にシフトさせ、三元触媒10上流側の空燃比がリッチに制御されるようにする。

【００３５】前記制御点のリッチ側へのシフトは、目標空燃比のリッチ空燃比への変更、実際の空燃比を検出するときの判定レベルの変更、空燃比フィードバック制御における操作量の変更など、種々の方法で行うことができる。

【００３６】Ｓ３では、前記リッチシフトの結果、酸素センサ17で検出される空燃比（Ａ／Ｆ）がリッチ側に張り付くようになったか否かを判別する。リッチ側への張り付きは、酸素センサ17の出力が最大リッチ出力（最大リッチ起電力）である状態が所定時間以上継続しているか否かに基づいて判別される。

【００３７】そして、酸素センサ17で検出される空燃比がリッチ側に張り付くようになるまで、リッチシフト状態を保持し、リッチ側に張り付くようになってからＳ６へ進む。

【００３８】一方、Ｓ１で酸素センサ17で検出される空燃比がリーンであると判別されると、Ｓ４へ進み、前記空燃比フィードバック制御における制御点をリーン側にシフトさせ、三元触媒10上流側の空燃比がリーンに制御されるようにする。

【００３９】そして、Ｓ５では、前記リーンシフトの結果、酸素センサ17で検出される空燃比（Ａ／Ｆ）がリーン側に張り付くようになったか否かを判別し、リーン側への張り付きが検出されるまで、リーンシフト状態を保持させる。

【００４０】例えば、酸素センサ17の出力がリッチであるときに、三元触媒10の上流側の空燃比をリッチにシフトさせると、継続的に酸素不足の排気が三元触媒10に流入することで、それまでに三元触媒10に吸着されていた酸素が酸化反応に使用されることで減少し、吸着されていた酸素を使い切ると、酸素センサ17で検出される三元触媒10下流側の排気空燃比はリッチに張り付くことになる。逆に、三元触媒10の上流側の空燃比をリーンにシフトさせると、継続的に酸素過剰の排気が三元触媒10に流入することで、三元触媒10に対する酸素の吸着量が増大し、吸着可能な酸素量が吸着されてしまうと、酸素センサ17で検出される三元触媒10下流側の排気空燃比はリーンに張り付くことになる。

【００４１】従って、前記Ｓ１～Ｓ５（初期化手段）の処理によって、三元触媒10の酸素ストレージ量は、０又は最大量に初期化されることになる。尚、上記では、酸素センサ17の検出結果から、リーンシフト・リッチシフトのいずれかを選択するようにしたが、予めリーンシフトとリッチシフトとのいずれを実行するかを決定しておいても良い。但し、上記のように、酸素センサ17の検出結果に応じてシフト方向を選択させるようにすれば、酸素ストレージ量の変化を少なくでき、初期化に要する時間を短縮できる。

【００４２】Ｓ３で、酸素センサ17の出力がリッチに張り付いていると判断されたとき、即ち、三元触媒10における酸素ストレージ量を０に初期化したときには、Ｓ６（空燃比反転手段）へ進み、逆に、空燃比フィードバック制御の制御点をリーンに反転させ、０にまで減少させた酸素ストレージ量を、酸素過剰の排気を三元触媒10に導入させることで増大させるようにする。

【００４３】また、Ｓ５で、酸素センサ17の出力がリーンに張り付いていると判断されたとき、即ち、三元触媒10における酸素ストレージ量を最大量に初期化したときには、Ｓ７（空燃比反転手段）へ進み、逆に、空燃比フィードバック制御の制御点をリッチに反転させ、最大量にまで増大させた酸素ストレージ量を、酸素不足の排気を三元触媒10に導入させることで減少させるようにする。

【００４４】Ｓ８では、空燃比センサ16で検出される三元触媒10の上流側における排気空燃比の理論空燃比に対するずれ量と、排気流量に相当する吸入空気流量Ｑとから、酸素過剰分又は酸素不足分を算出し、次のＳ９では、前記算出結果を時間積分することで、Ｓ６又はＳ７で空燃比制御点を反転させてからの酸素過剰分又は酸素不足分を算出させる（流入酸素量算出手段）。

【００４５】前記酸素過剰分とは、理論空燃比で燃焼させたときに対する酸素の増大分であり、前記酸素不足分とは、理論空燃比で燃焼させたときに対する酸素の減少分であり、Ｓ６でリーンシフトさせたときには酸素過剰分を演算させ、Ｓ７でリッチシフトさせたときには酸素不足分を演算させる。

【００４６】尚、前述のように、本実施形態では、吸入空気流量Ｑのデータを排気流量に相当する値として用いるので、吸入空気流量Ｑを検出するエアフローメータ13が排気流量検出手段に相当する。

【００４７】Ｓ10では、酸素センサ17の出力が、Ｓ６，Ｓ７でのシフト方向に対応して反転したか否かを判別する。具体的には、Ｓ６で空燃比制御点をリーン側にシフトさせた場合には、酸素センサ17の出力がリッチからリーンに反転したか否かを判別させ、Ｓ７で空燃比制御点をリッチ側にシフトさせた場合には、酸素センサ17の出力がリーンからリッチに反転したか否かを判別させる。

【００４８】例えばＳ２で空燃比をリッチシフトさせて、三元触媒10における酸素ストレージ量を０にしてから、Ｓ６で空燃比をリーンシフトさせた場合には、酸素過剰の排気が三元触媒10に流入するが、三元触媒10が酸素を吸着できる間は、三元触媒10下流側の排気空燃比はリーンに反転せず、三元触媒10の酸素ストレージ量が最大量となって酸素をそれ以上吸着できなくなると、三元触媒10下流側の空燃比がリーンに反転することになる（図４参照）。

【００４９】逆に、三元触媒10に最大量の酸素を吸着させてから空燃比をリッチにシフトさせた場合には、酸素不足の排気が三元触媒10に流入することで、三元触媒10に吸着されていた酸素が酸化反応に供され、三元触媒10に吸着されていた酸素を使い切って酸素を補うことができなくなると、三元触媒10下流側の空燃比がリッチに反転することになる。

【００５０】Ｓ10で、酸素センサ17の出力が反転したことが判別されると、Ｓ11へ進み、反転時までに積分された酸素過剰分又は不足分、即ち、三元触媒10に吸着された酸素量又は三元触媒10から放出された酸素量と、三元触媒10の初期状態での最大吸着量に応じて予め設定記憶しておいた基準酸素量とを比較する。

【００５１】そして、前記基準酸素量よりも酸素過剰分又は不足分の積分結果が多い場合には、三元触媒10に劣化が生じていないものと判断し、Ｓ12へ進んで、三元触媒10の正常判定を行う。

【００５２】一方、酸素過剰分又は不足分の積分結果が基準酸素量以下であるときには、三元触媒10の酸素ストレージ能力の劣化によって吸着できる酸素量が減少しているものと判断し、Ｓ13（劣化診断手段）へ進んで、三元触媒10の劣化判定を行う。Ｓ13で三元触媒10の劣化判定を行ったときには、劣化発生を警告灯などで警告すると良い。

【００５３】酸素ストレージ量を０から最大量にまで増大変化させる場合は、酸素過剰分が三元触媒10に吸着され、それ以上に吸着できなくなったときに、酸素センサ17の出力が反転することになるから、反転時点までに積分された酸素過剰分は、三元触媒10に吸着された酸素量（酸素ストレージ量）を示すことになり、該酸素ストレージ量が基準酸素量（基準酸素ストレージ量）よりも少ない場合には、酸素ストレージ能力が劣化したために、酸素ストレージ量が減少したものと判断する。

【００５４】また、酸素ストレージ量を最大量から０にまで減少変化させる場合は、酸素不足分だけ三元触媒10に吸着されていた酸素が減少し、酸素ストレージ量が０になったときに酸素センサ17の出力が反転することになるから、反転時点までに積分された酸素不足分は、三元触媒10に吸着されていた酸素量（酸素ストレージ量）を示すことになり、該酸素ストレージ量が基準酸素量（基準酸素ストレージ量）よりも少ない場合には、酸素ストレージ能力が劣化したために、酸素ストレージ量が減少したものと判断する。

【００５５】上記のように、本実施形態の劣化診断によると、三元触媒10において吸着可能な酸素量を検出して、初期状態の吸着可能量と比較することができるので、酸素ストレージ能力を定量的に判断でき、酸素ストレージ能力の劣化を高精度に診断できるものである。

【図面の簡単な説明】

【図１】請求項４の発明にかかる劣化診断装置の基本構成を示すブロック図。

【図２】実施の形態のシステム概略図。

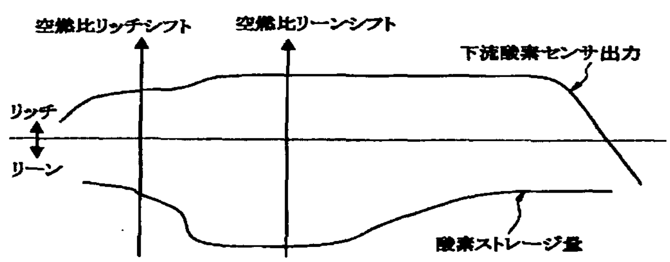
【図３】実施の形態における劣化診断制御を示すフローチャート。

【図４】実施の形態における劣化診断の特性を示すタイムチャート。

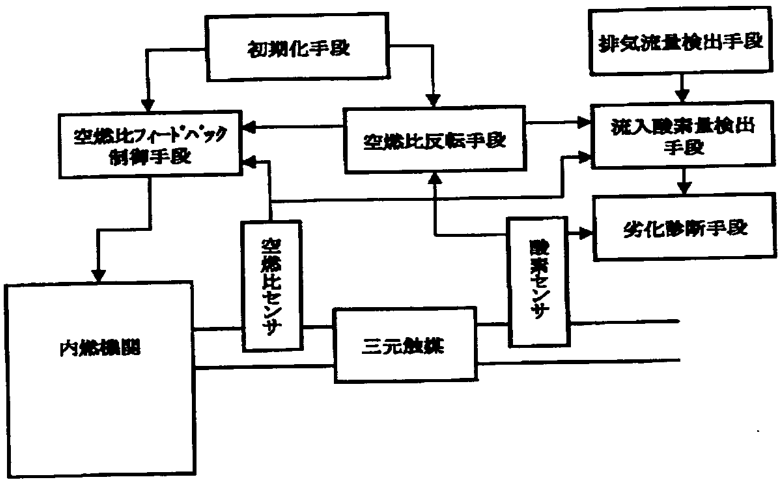
【符号の説明】

1　内燃機関
6　燃料噴射弁
10　三元触媒
12　コントロールユニット
13　エアフローメータ
14　クランク角センサ
16　空燃比センサ
17　酸素センサ

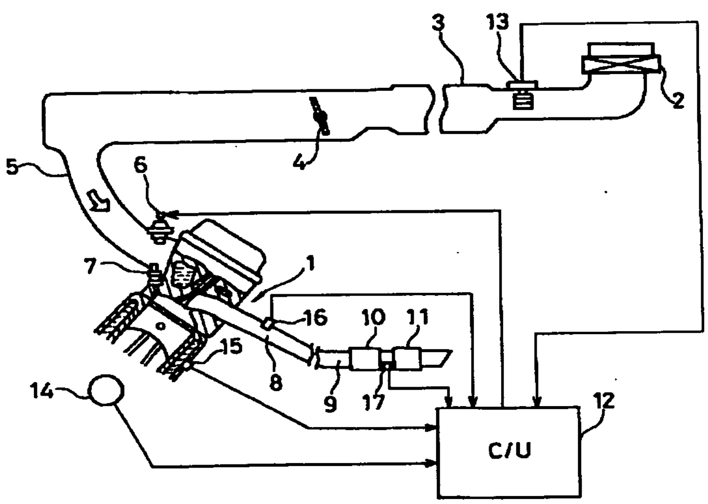
【図４】



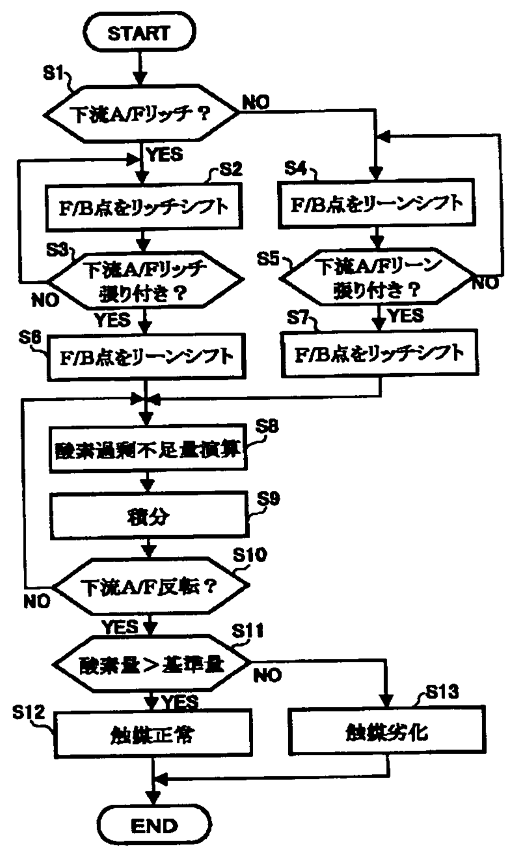
【図１】


初期化手段
排気流量検出手段
空燃比フィードバック制御手段
空燃比反転手段
流入酸素量検出手段
劣化診断手段
空燃比センサ
酸素センサ
内燃機関
三元触媒

【図２】


C/U

【図３】


START
S1
下流A/Fリッチ？
NO
YES
S2
F/B点をリッチシフト
S3
下流A/Fリッチ張り付き？
NO
YES
S6
F/B点をリーンシフト
S4
F/B点をリーンシフト
S5
下流A/Fリーン張り付き？
NO
YES
S7
F/B点をリッチシフト
S8
酸素過剰不足量演算
S9
積分
S10
下流A/F反転？
NO
YES
S11
酸素量＞基準量
NO
YES
S12
触媒正常
S13
触媒劣化
END

フロントページの続き

Ｆターム(参考)	3G084	BA24 DA04 EB14 EB15 FA08 FA20 FA30 FA33 FA38
	3G091	AA17 AA23 AA24 AA28 AB03 BA14 BA15 BA19 BA33 CB02 DA01 DA02 DB04 DB05 DB06 DB07 DB10 DB13 DC01 EA01 EA05 EA16 EA21 EA30 EA31 EA34 FB10 FB11 FB12 HA36 HA37
	3G301	JB09 LB02 MA01 MA12 NA03 NA04 NA05 NC01 ND06 NE13 NE15 NE16 NE17 PA01Z PD03Z PD04Z PD09A PD09Z PE01Z PE04Z PE08Z

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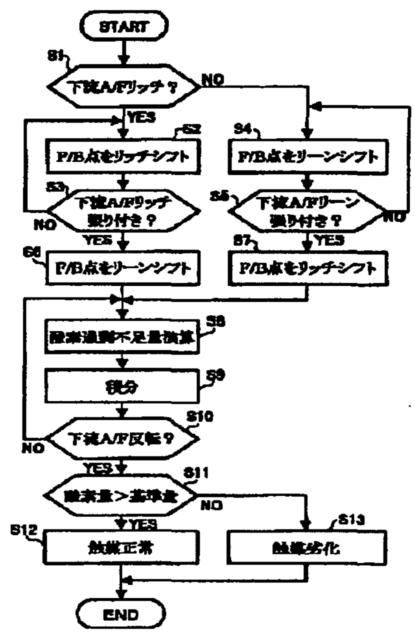
(72) Inventor: **TAKAHASHI KOJI**

(54) CATALYST DETERIORATION DIAGNOSTIC DEVICE FOR INTERNAL COMBUSTION ENGINE

(57) Abstract:

PROBLEM TO BE SOLVED: To diagnose the deterioration of oxygen storage capacity of three-way catalyst with high precision.

SOLUTION: An air-fuel ratio in the upstream of catalyst is shifted to a rich or lean condition and oxygen storage amount in three-way catalyst is initialized to 0 or the maximum amount (S1 to S5). Then, the air-fuel ratio in the upstream of catalyst is inverted (S6, S7) to increase or decrease the oxygen storage amount, and oxygen excess amount or oxygen deficiency amount after the inversion is calculated for time-integration (S8, S9). When an air-fuel ratio in the downstream of the catalyst is inverted (S10), the oxygen excess amount or oxygen deficiency amount integrated thus far is compared with a reference oxygen amount (S11), and the three-way catalyst is judged to be deteriorated (S13) if the amount is smaller than the reference oxygen amount.



CLAIMS

[Claim(s)]
[Claim 1] Catalyst de-activation diagnostic equipment of the internal combustion engine which is the catalyst de-activation diagnostic equipment which diagnoses degradation of the three way component catalyst which has the oxygen storage capacity infixed in the flueway of an internal combustion engine, and is characterized by diagnosing degradation of the oxygen storage capacity of the aforementioned three way component catalyst from correlation with the amount of inflow oxygen to rich RIN and the aforementioned three way component catalyst of an exhaust air air-fuel ratio of the aforementioned three-way-component-catalyst downstream.
[Claim 2] From that the exhaust air air-fuel ratio of the downstream of the aforementioned three way component catalyst is rich, or the state where it has stuck to RIN Or it controls richly. the exhaust air air-fuel ratio of this downstream is reversed -- it should make -- the exhaust air air-fuel ratio of the upstream of the aforementioned three way component catalyst -- RIN -- Integrate a part for an excess and the insufficiency of the amount of inflow oxygen to the aforementioned three way component catalyst after starting control of the exhaust air air-fuel ratio of this upstream, and when RIN or the aforementioned integrated value at the time of being richly reversed is below a reference value, the exhaust air air-fuel ratio of the aforementioned downstream Catalyst de-activation diagnostic equipment of the internal combustion engine according to claim 1 characterized by diagnosing degradation generating of the oxygen storage capacity of the aforementioned three way component catalyst.
[Claim 3] Catalyst de-activation diagnostic equipment of the internal combustion engine according to claim 2 characterized by computing a part for an excess and the insufficiency of the aforementioned amount of inflow oxygen from the amount of gaps and exhaust air flow rate from theoretical air fuel ratio of an exhaust air air-fuel ratio of the aforementioned three way component catalyst. [of an upstream]
[Claim 4] The air-fuel ratio sensor which is the catalyst de-activation diagnostic equipment which diagnoses degradation of the three way component catalyst which has the oxygen storage capacity infixed in the flueway of an internal combustion engine, is infixed in the flueway of the upstream of the aforementioned three way component catalyst, and detects an exhaust air air-fuel ratio linearly, in agreement with a target air-fuel ratio in the air-fuel ratio detected by this air-fuel ratio sensor -- it should make -- an engine's combustion -- with the air-fuel ratio feedback control means which carries out feedback control of the air-fuel ratio of a gaseous mixture The control point of the air-fuel ratio feedback control by this air-fuel ratio feedback control means Rich or the initialization means shifted to RIN, or [that it is infixed in the flueway of the downstream of the aforementioned three way component catalyst, and an exhaust air air-fuel ratio is rich] -- with the oxygen sensor which detects whether it is RIN It is based on that the exhaust air air-fuel ratio detected by the aforementioned oxygen sensor since the control point by the aforementioned initialization means is shifted is rich, or having stuck to RIN. The control point of the air-fuel ratio feedback control by the aforementioned air-fuel ratio feedback control means RIN or the air-fuel ratio reversal means reversed richly, A part for an excess and the insufficiency of the amount of inflow oxygen to the aforementioned three way component catalyst of

since the control point by exhaust air flow rate detection means to detect an engine's exhaust air flow rate, and the aforementioned air-fuel ratio reversal means is reversed An amount calculation means of inflow oxygen to compute and integrate from the amount of gaps to the theoretical air fuel ratio of the exhaust air air-fuel ratio detected by the aforementioned air-fuel ratio sensor, and an engine's exhaust air flow rate detected with the aforementioned exhaust air flow rate detection means, When the exhaust air air-fuel ratio detected by the aforementioned oxygen sensor corresponding to reversal of the control point by the aforementioned air-fuel ratio reversal means is reversed Catalyst de-activation diagnostic equipment of the internal combustion engine characterized by having measured the amount of criteria oxygen beforehand remembered to be a part for an excess and the insufficiency of the amount of inflow oxygen integrated with the aforementioned amount calculation means of inflow oxygen by then, and being constituted including a degradation diagnostic means to diagnose degradation of the oxygen storage capacity of the aforementioned three way component catalyst.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] Especially this invention relates to the equipment which diagnoses degradation of the oxygen storage capacity of the three way component catalyst which has oxygen storage capacity about the catalyst de-activation diagnostic equipment of an internal combustion engine.
[0002]
[Description of the Prior Art] In the engine which equips conventionally the upstream of the three way component catalyst infixed in an engine's exhaust air system with the air-fuel ratio sensor which detects an air-fuel ratio linearly, and performs air-fuel ratio feedback control by this air-fuel ratio sensor The oxygen sensor which detects whether it is RIN is prepared. or [that an air-fuel ratio is rich to theoretical air fuel ratio to the downstream of the aforementioned three way component catalyst] -- Based on the ratio of the tracing length of the output of this oxygen sensor or the tracing length of the output of the aforementioned oxygen sensor, and the tracing length of the output of the aforementioned air-fuel ratio sensor, there was diagnostic equipment which diagnoses degradation of a three way component catalyst (refer to JP,9-125936,A).
[0003]
[Problem(s) to be Solved by the Invention] however -- although according to the above-mentioned conventional degradation diagnostic equipment a reliable diagnosis can be performed when the tracing length of the output of an air-fuel ratio sensor is a predetermined range -- the aforementioned predetermined one -- if out of range, there was possibility of an incorrect diagnosis, and there was a problem that diagnosable conditions were limited
[0004] this invention is made in view of the above-mentioned trouble, and it aims at offering the diagnostic equipment which can diagnose certainly [there is no incorrect diagnosis and] degradation of the oxygen storage capacity of a three way component catalyst.
[0005]
[Means for Solving the Problem] Therefore, the catalyst de-activation diagnostic equipment of the internal combustion engine concerning invention of a claim 1 is catalyst de-activation diagnostic equipment which diagnoses degradation of the three way component catalyst which has the oxygen storage capacity infixed in the flueway of an internal combustion engine, and was taken as the composition which diagnoses degradation of the oxygen storage capacity of the aforementioned three way component catalyst from correlation with the amount of inflow oxygen to rich RIN and the aforementioned three way component catalyst of an exhaust air air-fuel ratio of the aforementioned three-way-component-catalyst downstream.
[0006] For example, if the exhaust air air-fuel ratio of the aforementioned upstream is RIN while the atmosphere of a three way component catalyst serves as oxygen deficiency, the oxygen with which the three way component catalyst was adsorbed will be used for oxidation reaction and the amount of oxygen storage of a three way component catalyst will fall gradually, if the exhaust air air-fuel ratio in

the upstream of a three way component catalyst is rich, the atmosphere of a three way component catalyst will serve as hyperoxia, and the amount of oxygen storage of a three way component catalyst will carry out increase change gradually. Therefore, change of the exhaust air air-fuel ratio of the downstream of a three way component catalyst The delay according to the amount of oxygen storage which can stick to a three way component catalyst will be produced to change of the exhaust air air-fuel ratio of an upstream. the actual amount of oxygen storage If the amount of oxygen storage which can presume from the amount of oxygen which flowed into the catalyst by the time air-fuel ratio change of a downstream occurred, and is this presumed is decreasing rather than the amount of oxygen storage in an initial state, degradation of the oxygen storage capacity of a three way component catalyst will be judged.
[0007] In addition, in this application, rich RIN of an air-fuel ratio shall show rich RIN to theoretical air fuel ratio. In invention according to claim 2, from that the exhaust air air-fuel ratio of the downstream of the aforementioned three way component catalyst is rich, or the state where it has stuck to RIN Or it controls richly. the exhaust air air-fuel ratio of this downstream is reversed -- it should make -- the exhaust air air-fuel ratio of the upstream of the aforementioned three way component catalyst -- RIN -- Integrate a part for an excess and the insufficiency of the amount of inflow oxygen to the aforementioned three way component catalyst after starting control of the exhaust air air-fuel ratio of this upstream, and when RIN or the aforementioned integrated value at the time of being richly reversed is below a reference value, the exhaust air air-fuel ratio of the aforementioned downstream It considered as the composition which diagnoses degradation generating of the oxygen storage capacity of the aforementioned three way component catalyst.
[0008] According to this composition, the state where the exhaust air air-fuel ratio of a catalyst downstream has stuck richly can be presumed to be that to which the amount of oxygen storage has reached the peak in the state where could presume that from which the amount of oxygen storage is abbreviation 0, and it has stuck to RIN. And that the amount of oxygen storage should be increased or decreased from the starting state, the exhaust air air-fuel ratio of an upstream is controlled, and it judges whether the amount of oxygen storage changed with reversal of the exhaust air air-fuel ratio of a downstream even to a peak or 0. If it asks for a part for an excess and the insufficiency of the amount of inflow oxygen to a catalyst until the exhaust air air-fuel ratio of a downstream is reversed as a value equivalent to the actual amount of oxygen storage on the other hand and is decreasing rather than the expected amount of oxygen storage, degradation of a three way component catalyst will be judged.
[0009] In invention according to claim 3, a part for an excess and the insufficiency of the aforementioned amount of inflow oxygen was considered as the composition computed from the amount of gaps and exhaust air flow rate from theoretical air fuel ratio of an exhaust air air-fuel ratio of the aforementioned three way component catalyst. [of an upstream]
[0010] According to this composition, when having shifted to the RIN side, it is in a hyperoxia state, when the air-fuel ratio has shifted from the theoretical air fuel ratio of the exhaust air air-fuel ratio of an upstream to the rich side, it is in an oxygen-deficiency state, the degree of oxygen deficiency or hyperoxia becomes large, so that the amount of gaps from theoretical air fuel ratio is large, and the amount of hyperoxia and an oxygen deficiency are calculated according to an exhaust air flow rate. In addition, since an exhaust air flow rate is an engine's intake air flow and almost same amount, it can ask for a part for a part for hyperoxia, and oxygen deficiency by making an intake air flow into an exhaust air flow rate equivalent value.
[0011] Invention according to claim 4 is catalyst de-activation diagnostic equipment which diagnoses degradation of the three way component catalyst which has the oxygen storage capacity infixed in the flueway of an internal combustion engine, and as shown in drawing 1 , it is constituted.
[0012] In drawing 1 , an air-fuel ratio sensor is infixed in the flueway of the upstream of the aforementioned three way component catalyst, and detects an exhaust air air-fuel ratio linearly. an air-fuel ratio feedback control means is in agreement with a target air-fuel ratio in the air-fuel ratio detected by the air-fuel ratio sensor -- it should make -- an engine's combustion -- feedback control of the air-fuel ratio of a gaseous mixture is carried out

[0013] Here, an initialization means shifts the control point of the air-fuel ratio feedback control by the air-fuel ratio feedback control means to rich or RIN. or [that an oxygen sensor is infixed in the flueway of the downstream of the aforementioned three way component catalyst, and its exhaust-air air-fuel ratio is rich] -- the control point of that are the sensor which detects whether it is RIN and an air-fuel ratio reversal means has the rich exhaust-air air-fuel ratio of the downstream of the aforementioned three way component catalyst detected by the aforementioned oxygen sensor since the control point by the aforementioned initialization means is shifted, or the air-fuel ratio feedback control according to the aforementioned air-fuel ratio feedback-control means based on having stuck to RIN -- RIN -- or it makes reversed richly

[0014] The amount calculation means of inflow oxygen computes and integrates a part for an excess and the insufficiency of the amount of inflow oxygen to the aforementioned three way component catalyst of since the control point by the air-fuel ratio reversal means is reversed from the amount of gaps to the theoretical air fuel ratio of the exhaust air air-fuel ratio detected by the aforementioned air-fuel ratio sensor, and an engine's exhaust air flow rate detected with an exhaust air flow rate detection means.

[0015] And when the exhaust-air air-fuel ratio detected by the aforementioned oxygen sensor corresponding to reversal of the control point by the aforementioned air-fuel ratio reversal means is reversed, a degradation diagnostic means measures the amount of criteria oxygen beforehand remembered to be a part for an excess and the insufficiency of the amount of inflow oxygen integrated with the aforementioned amount calculation means of inflow oxygen by then, and diagnoses degradation of the oxygen storage capacity of the aforementioned three way component catalyst.

[0016] according to this composition, the amount of oxygen storage is first decreased or increase changed for the control point of air-fuel ratio feedback control by rich or making it shift to RIN -- making -- making -- this -- by rich or RIN shift, when it sticks to RIN, it is regarded as that the exhaust air air-fuel ratio of a downstream is rich, or the thing to which the amount of oxygen storage reached 0 or the peak And the amount of oxygen storage initialized by doing in this way to make it change even to 0 from the maximum or the maximum from 0 Or it is richly made reversed and corresponds to this air-fuel ratio reversal. the control point of the exhaust air air-fuel ratio of an upstream -- RIN -- RIN or when richly reversed, the air-fuel ratio of a downstream It is judged as that from which the amount of oxygen storage changed even to 0 from the peak or the peak from 0, and a part for an excess and the insufficiency of the amount of inflow oxygen to a catalyst in the meantime shall show the actual amount of oxygen storage, and compares with the amount of criteria oxygen of oxygen storage, i.e., the amount in the normal state of a three way component catalyst.

[0017]

[Effect of the Invention] According to the catalyst de-activation diagnostic equipment of the internal combustion engine concerning invention of a claim 1, the state of the amount of oxygen storage in a three way component catalyst is judged from rich RIN of the exhaust air air-fuel ratio of the downstream of a three way component catalyst. In order to presume the actual amount of oxygen storage from correlation with this judgment result and the amount of inflow oxygen to a three way component catalyst, Degradation of the oxygen storage capacity of a three way component catalyst can be quantitatively judged as a fall of the amount of oxygen storage, with there is an effect of the ability to make a degradation diagnosis perform with a sufficient precision stably.

[0018] According to invention according to claim 2, it is effective in the ability to be able to presume the amount of oxygen to which the three way component catalyst was able to be made to stick, or the amount of oxygen in which the three way component catalyst was adsorbed, with able to diagnose degradation of the oxygen storage capacity of a three way component catalyst with a sufficient precision from the amount of inflow oxygen to the three way component catalyst when changing the amount of oxygen storage in a three way component catalyst even to 0 from a peak or a peak from 0.

[0019] According to invention according to claim 3, it is effective in the ability to presume a part for the insufficiency of the amount of oxygen which flows into a three way component catalyst, and an excess with a sufficient precision, with presume the amount of oxygen storage in a three way component catalyst with high precision.

[0020] According to invention according to claim 4, since the amount of oxygen storage in a three way component catalyst is changed even to 0 from a peak or a peak from 0 in shifting the control point of air-fuel ratio feedback control and the actual amount of oxygen storage in a three way component catalyst is presumed from the amount of inflow oxygen to the three way component catalyst at this time, it is effective in the ability to be able to diagnose reduction of the amount of oxygen storage by degradation with a sufficient precision.
[0021]
[Embodiments of the Invention] The gestalt of operation of this invention is explained below. In drawing 2 which shows the system configuration of the gestalt of operation, air is inhaled by the internal combustion engine 1 through an air intake duct 3, a throttle valve 4, and an inlet manifold 5 from an air cleaner 2.
[0022] The fuel injection valve 6 is formed in the branch section of an inlet manifold 5 for every cylinder. The aforementioned fuel injection valve 6 is an electromagnetic fuel injection valve which is energized by the solenoid, opens, and an energization halt is carried out and is closed, and carries out injection supply of the fuel which was fed from the fuel pump which is energized by the injection pulse signal from the control unit 12 mentioned later, opens, and is not illustrated, and was adjusted to the predetermined pressure by the pressure regulator into an inlet manifold 5. In addition, you may be the composition in which the aforementioned fuel injection valve 6 injects direct fuel to a combustion chamber.
[0023] The ignition plug 7 is formed in an engine's 1 combustion chamber, respectively, jump spark ignition is carried out by this, and ignition combustion of the gaseous mixture is carried out. And from an engine 1, exhaust air is discharged through an exhaust manifold 8, a jet pipe 9, a three way component catalyst 10, and a muffler 11. that in which the aforementioned three way component catalyst 10 has the oxygen storage effect -- it is -- CO in an exhaust air component, and HC -- oxidizing -- moreover, NOx the catalyst which is returned and is converted into other harmless matter -- it is -- engine inhalation -- when burning a gaseous mixture in theoretical air fuel ratio, both transformation efficiency will become the best
[0024] A control unit 12 is equipped with the microcomputer constituted including CPU, ROM, RAM, an A/D converter, and an input/output interface, inputs the detecting signal from various kinds of sensors, and like the after-mentioned, data processing of it is carried out and it controls the operation of fuel injection valve 6 grade.
[0025] As various kinds of aforementioned sensors, the air flow meters 13, such as a heat ray formula or a flap formula, are formed into the air intake duct 3, and the voltage signal according to an engine's 1 intake air flow Q is outputted.
[0026] Moreover, the crank angle sensor 14 is formed and the degree signal REF of reference angle for every predetermined piston position and the unit angle signal POS for every unit angle are outputted. The engine rotational speed Ne is computable from measuring the generating period of the aforementioned degree signal REF of reference angle, or the occurrences of the aforementioned unit angle signal POS in a predetermined time here.
[0027] Moreover, the coolant temperature sensor 15 which detects the circulating water temperature Tw of an engine's 1 water jacket is formed. Furthermore, the air-fuel ratio sensor 16 which detects an exhaust air air-fuel ratio linearly is formed in the set section of the exhaust manifold 8 used as the upstream of the aforementioned three way component catalyst 10, and the oxygen sensor (SUTOIKI sensor) 17 which detects rich RIN of an exhaust air air-fuel ratio is formed in the upstream of a muffler 11 by the downstream of the aforementioned three way component catalyst 10.
[0028] In here, while the microcomputer CPU built in the control unit 12 calculates the basic fuel oil consumption Tp based on the intake air flow Q and the engine rotational speed Ne which are detected by each aforementioned sensor, it carries out an operation setup of the various amendment coefficients C OEF of an amendment sake for the aforementioned basic fuel oil consumption Tp based on a circulating water temperature Tw etc.
[0029] Moreover, when predetermined feedback control conditions are satisfied, the control unit 12

which has a function as an air-fuel ratio feedback control means sets up the aforementioned basic injection quantity Tp by PID control etc. so that the air-fuel ratio detected by the aforementioned air-fuel ratio sensor 16 may be in agreement with a target air-fuel ratio in the air-fuel ratio feedback correction factor LMD of an amendment sake.

[0030] In addition, you may be the composition of adding amendment to the air-fuel ratio feedback control using the aforementioned air-fuel ratio sensor 16 based on rich RIN of the air-fuel ratio detected by the oxygen sensor 17.

[0031] And the various aforementioned amendment coefficient-C OEF(s), the air-fuel ratio feedback correction factor LMD, a part [amended] Ts according to battery voltage further, etc. amend the aforementioned basic fuel oil consumption Tp, the final fuel oil consumption Ti is calculated, and the injection pulse signal of the pulse width equivalent to this fuel oil consumption Ti is outputted to a fuel injection valve 6 to predetermined timing.

[0032] On the other hand, the aforementioned control unit 12 is equipped with degradation of the aforementioned three way component catalyst 10, and the diagnostic function for diagnosing degradation of oxygen storage capacity especially as shown in the flow chart of drawing 3 .

[0033] In the flow chart of drawing 3 , it first distinguishes whether the exhaust air air-fuel ratio (A/F) of three-way-component-catalyst 10 downstream detected by the oxygen sensor 17 is rich, or it is RIN by S1.

[0034] And when rich, it progresses to S2, the control point (F/B point) in the aforementioned air-fuel ratio feedback control is shifted to a rich side, and the air-fuel ratio of three-way-component-catalyst 10 upstream is controlled richly.

[0035] The shift by the side of [the aforementioned control point] rich can be performed by various methods, such as change of the control input in change of the judgment level when detecting change to the rich air-fuel ratio of a target air-fuel ratio, and an actual air-fuel ratio, and air-fuel ratio feedback control.

[0036] In S3, it distinguishes whether the air-fuel ratio (A/F) detected by the oxygen sensor 17 come to stick to a rich side as a result of the aforementioned rich shift. The ball up by the side of rich is distinguished based on whether the state where the output of an oxygen sensor 17 is the maximum rich output (the maximum rich electromotive force) is continuing more than the predetermined time.

[0037] And since a rich shift state is held and it comes to stick to a rich side until the air-fuel ratio detected by the oxygen sensor 17 comes to stick to a rich side, it progresses to S6.

[0038] On the other hand, if it is distinguished that the air-fuel ratio detected by the oxygen sensor 17 by S1 is RIN, it will progress to S4, the control point in the aforementioned air-fuel ratio feedback control will be shifted to a RIN side, and the air-fuel ratio of three-way-component-catalyst 10 upstream will be controlled by RIN.

[0039] And a RIN shift state is made to hold in S5 until it distinguishes whether the air-fuel ratio (A/F) detected by the oxygen sensor 17 come to stick to a RIN side as a result of the aforementioned RIN shift and the ball up by the side of RIN is detected.

[0040] For example, the exhaust air air-fuel ratio of three-way-component-catalyst which will be detected by oxygen sensor 17 if oxygen which it decreased by oxygen from which three way component catalyst 10 was adsorbed by then because exhaust air with continuously insufficient oxygen will flow into three way component catalyst 10 if air-fuel ratio of upstream of three way component catalyst 10 is richly shifted when output of oxygen sensor 17 is rich being used for oxidation reaction, and was adsorbed is used up 10 downstream will stick richly. On the contrary, when the amount of adsorption of oxygen to a three way component catalyst 10 increases and the amount of oxygen to which it can stick adsorbs because exhaust air of hyperoxia will flow into a three way component catalyst 10 continuously if the air-fuel ratio of the upstream of a three way component catalyst 10 is shifted to RIN, the exhaust air air-fuel ratio of three-way-component-catalyst 10 downstream detected by the oxygen sensor 17 will stick to RIN.

[0041] Therefore, the amount of oxygen storage of a three way component catalyst 10 will be initialized by processing of the above S1-S5 (initialization means) at 0 or a peak. In addition, above, although

either of the RIN shift rich shifts was chosen from the detection result of an oxygen sensor 17, you may determine any of a RIN shift and a rich shift are performed beforehand. However, as mentioned above, if it is made to make the shift direction choose according to the detection result of an oxygen sensor 17, change of the amount of oxygen storage can be lessened and the time which initialization takes can be shortened.

[0042] It is made to increase the amount of oxygen storage which it progressed [amount] to S6 (air-fuel ratio reversal means), made RIN reverse the control point of air-fuel ratio feedback control conversely, and decreased even 0 by S3 when the output of an oxygen sensor 17 was judged to have stuck richly (i.e., when the amount of oxygen storage in a three way component catalyst 10 is initialized to 0) by making exhaust air of hyperoxia introduce into a three way component catalyst 10.

[0043] Moreover, it is made to decrease the amount of oxygen storage which it progressed [amount] to S7 (air-fuel ratio reversal means), reversed richly the control point of air-fuel ratio feedback control conversely, and increased even the peak by S5 when the output of an oxygen sensor 17 was judged to have stuck to RIN (i.e., when the amount of oxygen storage in a three way component catalyst 10 is initialized to a peak) by making exhaust air with insufficient oxygen introduce into a three way component catalyst 10.

[0044] A part for hyperoxia and an oxygen insufficiency are computed and a part for hyperoxia and the oxygen insufficiency of since an air-fuel ratio control point is reversed by S6 or S7 is made to compute by carrying out the time quadrature of the aforementioned calculation result by S8 the following S9 from the intake air flow Q equivalent to the amount of gaps to theoretical air fuel ratio and exhaust air flow rate of the exhaust air air-fuel ratio in the upstream of the three way component catalyst 10 detected by the air-fuel ratio sensor 16 (the amount calculation means of inflow oxygen).

[0045] In a part for the aforementioned hyperoxia, when it is made to burn in theoretical air fuel ratio, are an increased part of oxygen, the aforementioned oxygen insufficiency is a decrement of oxygen, when it is made to burn in theoretical air fuel ratio, when carrying out a RIN shift by S6, a part for hyperoxia is made to calculate, and an oxygen insufficiency is made to calculate when carrying out a rich shift by S7.

[0046] In addition, as mentioned above, with this operation form, since the data of an intake air flow Q are used as a value equivalent to an exhaust air flow rate, the air flow meter 13 which detects an intake air flow Q is equivalent to an exhaust air flow rate detection means.

[0047] In S10, the output of an oxygen sensor 17 distinguishes whether corresponding to the shift direction of S6 and S7, it was reversed. When it makes it distinguish whether the output of an oxygen sensor 17 was specifically reversed to rich shell RIN when an air-fuel ratio control point was shifted to a RIN side by S6 and an air-fuel ratio control point is shifted to a rich side by S7, the output of an oxygen sensor 17 makes it distinguish from RIN whether to have been richly reversed.

[0048] For example, although exhaust air of hyperoxia flows into a three way component catalyst 10 when the RIN shift of the air-fuel ratio is carried out by S6 after carrying out the rich shift of the air-fuel ratio by S2 and setting the amount of oxygen storage in a three way component catalyst 10 to 0 While a three way component catalyst 10 can adsorb oxygen, when the exhaust air air-fuel ratio of three-way-component-catalyst 10 downstream is not reversed to RIN, but the amount of oxygen storage of a three way component catalyst 10 turns into a peak and it becomes impossible to adsorb oxygen more than it, the air-fuel ratio of three-way-component-catalyst 10 downstream will be reversed to RIN (refer to drawing 4).

[0049] On the contrary, after making the oxygen of a peak stick to a three way component catalyst 10, when an air-fuel ratio is shifted richly, and oxidation reaction is presented with the oxygen with which the three way component catalyst 10 was adsorbed, it uses up the oxygen with which the three way component catalyst 10 was adsorbed and it becomes impossible to compensate oxygen with exhaust air with insufficient oxygen flowing into a three way component catalyst 10, the air-fuel ratio of three-way-component-catalyst 10 downstream will be richly reversed.

[0050] By S10, if it is distinguished that the output of an oxygen sensor 17 was reversed, it progresses to S11 and measures the amount of oxygen emitted from the amount of oxygen or three way component

catalyst 10 by which a part for the hyperoxia with which it integrated by the time of reversal, and the insufficiency 10, i.e., a three way component catalyst, were adsorbed, and the amount of criteria oxygen which carried out setting storage beforehand according to the maximum amount of adsorption in the initial state of a three way component catalyst 10.

[0051] And when there are more integration results of a part for hyperoxia and an insufficiency than the aforementioned amount of criteria oxygen, it is judged as what degradation has not produced, it progresses to S12, and the normal judging of a three way component catalyst 10 is performed to a three way component catalyst 10.

[0052] On the other hand, when the integration result of a part for hyperoxia and an insufficiency is below the amount of criteria oxygen, it is judged as that to which the amount of oxygen to which it can stick by degradation of the oxygen storage capacity of a three way component catalyst 10 is decreasing, it progresses to S13 (degradation diagnostic means), and the degradation judging of a three way component catalyst 10 is performed. When the degradation judging of a three way component catalyst 10 is performed by S13, it is good to warn of degradation generating by the alarm lamp etc.

[0053] When making even a peak carry out increase change of the amount of oxygen storage from 0 Since the output of an oxygen sensor 17 will be reversed when a three way component catalyst 10 is adsorbed and it becomes impossible for the amount of hyperoxia to adsorb more than it, the amount of [with which it integrated by the reversal point in time] hyperoxia Since the amount of oxygen (the amount of oxygen storage) in which the three way component catalyst 10 was adsorbed will be shown, and oxygen storage capacity deteriorated when there were few these amounts of oxygen storage than the amount of criteria oxygen (the amount of criteria oxygen storage), it is judged as that to which the amount of oxygen storage decreased.

[0054] Moreover, when making even 0 carry out reduction change of the amount of oxygen storage from a peak Since the output of an oxygen sensor 17 will reverse only an oxygen insufficiency when the oxygen with which the three way component catalyst 10 was adsorbed decreases and the amount of oxygen storage is set to 0 The oxygen insufficiency with which it integrated by the reversal point in time will show the amount of oxygen (the amount of oxygen storage) in which the three way component catalyst 10 was adsorbed. Since oxygen storage capacity deteriorated when there were few these amounts of oxygen storage than the amount of criteria oxygen (the amount of criteria oxygen storage), it is judged as that to which the amount of oxygen storage decreased.

[0055] As mentioned above, since according to the degradation diagnosis of this operation form the amount of oxygen to which it can stick can be detected in a three way component catalyst 10 and it can compare with the amount of an initial state which can be adsorbed, oxygen storage capacity can be judged quantitatively and degradation of oxygen storage capacity can be diagnosed with high precision.

[Translation done.]

PRIOR ART

[Description of the Prior Art] The upstream of the three way component catalyst infixed in an engine's exhaust air system is conventionally equipped with the air-fuel ratio sensor which detects an air-fuel ratio linearly, and it is this air-fuel ratio sensor. or [that an air-fuel ratio is rich to theoretical air fuel ratio in the engine which performs air-fuel ratio feedback control to the downstream of the aforementioned three way component catalyst] -- the oxygen sensor which detects whether it is RIN was prepared, and there was diagnostic equipment which diagnoses degradation of a three way component catalyst based on the ratio of the locus length of the output of this oxygen sensor or the locus length of the output of the aforementioned oxygen sensor, and the locus length of the output of the aforementioned air-fuel ratio sensor (refer to JP,9-125936,A)

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The block diagram showing the basic composition of the degradation diagnostic equipment concerning invention of a claim 4.
[Drawing 2] The system-outline view of the gestalt of operation.
[Drawing 3] The flow chart which shows the degradation diagnostic control in the gestalt of operation.
[Drawing 4] The timing diagram which shows the property of the degradation diagnosis in the gestalt of operation.
[Description of Notations]
1 Internal Combustion Engine
6 Fuel Injection Valve
10 Three Way Component Catalyst
12 Control Unit
13 Air Flow Meter
14 Crank Angle Sensor
16 Air-fuel Ratio Sensor
17 Oxygen Sensor

[Translation done.]

* NOTICES *

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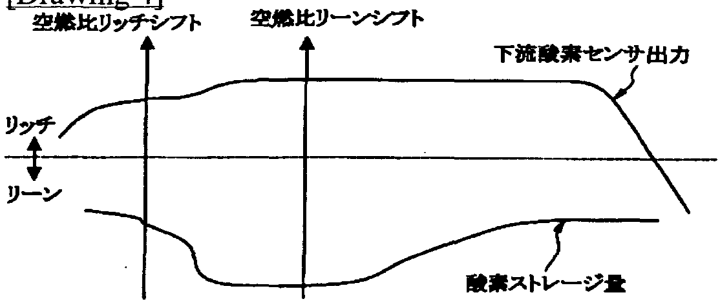
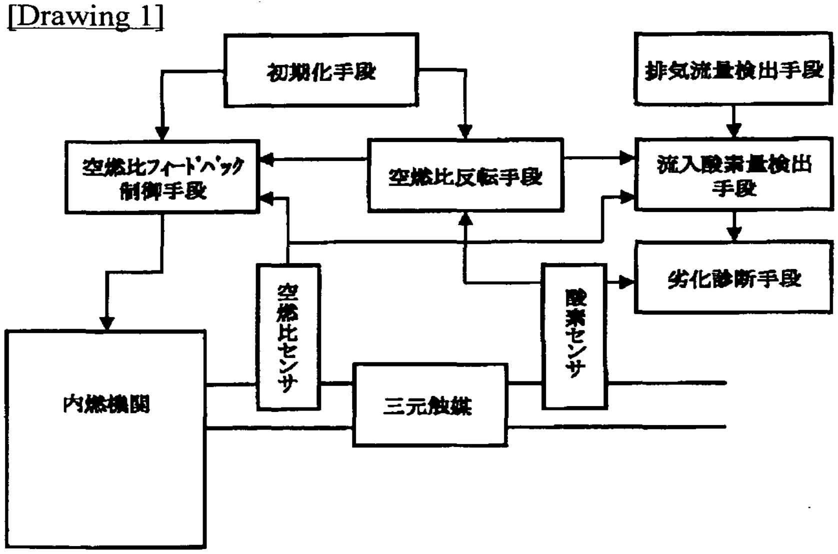
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

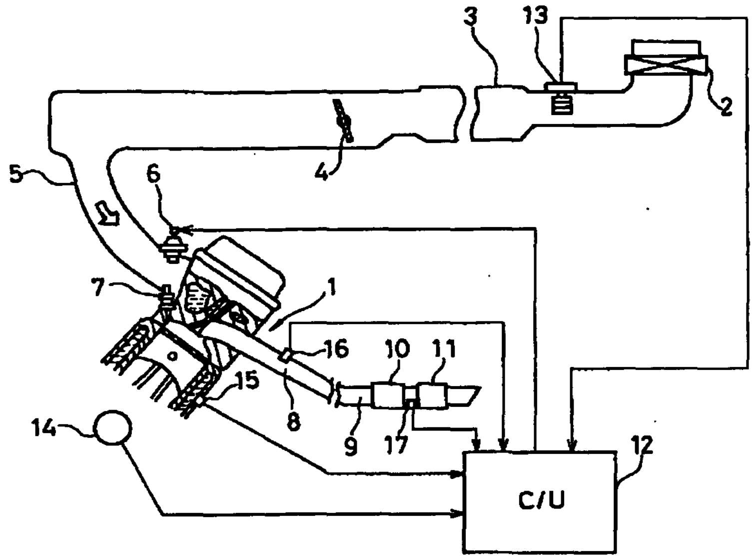
[Drawing 4]



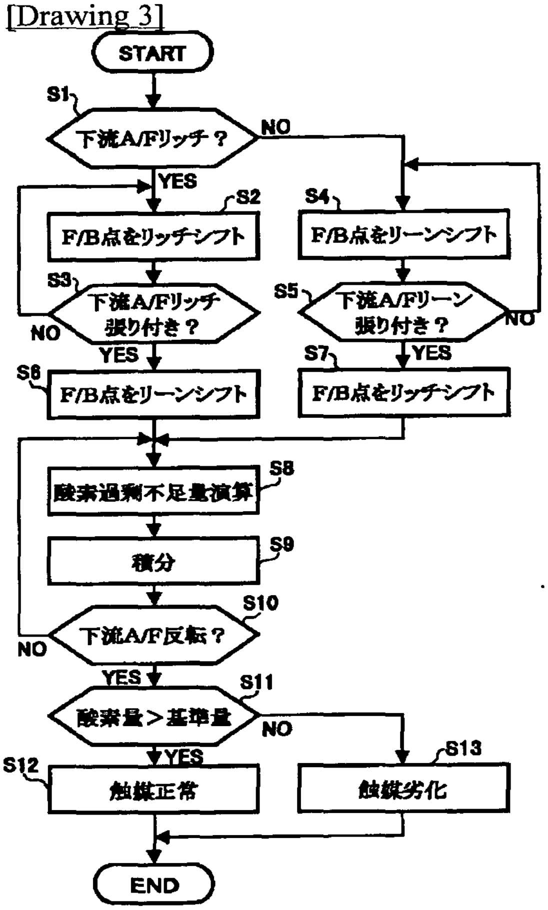
[Drawing 1]



[Drawing 2]



[Drawing 3]



[Translation done.]